Without *Coup D'oeil,* But With Responsibility:
Determining Tactical Centers of Gravity and Decisive Points

A Monograph
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In 1986, the US Army introduced Carl von Clausewitz's concept of center of gravity in Field Manual (FM) 100-5, Operations, and defined it as the "hub of all power and movement upon which everything depends." The manual explicity stated that the concept was applicable at all levels of war. The 1993 revision of FM 100-5, Operations kept the concept of center of gravity; however, it suggested that it was not applicable at the tactical level of war.

This study examines the relevance of Clausewitz's concept center of gravity and Antoine Henri Jomini's concept of decisive point at the tactical level of war (according to FM 100-5,Operations, the two concepts are inextricably linked). It determines that the center of gravity is that source of power most critical to mission accomplishment. Decisive points grant a commander an opportunity to indirectly attack a center of gravity; thus, they provide a marked advantage. Both concepts are valid at the tactical level of war.

Furthermore, with the aid of two historical examples, this study illustrates that an analytical comparison of combat power could help commanders in determining tactical centers of gravity and decisive points.

This study recommends that when the Army revises FM 100-5, Operations, the doctrine state definitively that the concepts of center of gravity and decisive points are applicable at the tactical level of war.

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I. Introduction

Both the 1986 and 1993 versions of Field Manual (FM) 100-5, Operations, the Army's keystone doctrinal text, reflect Carl von Clausewitz's military theory. Each manual adopted Clausewitz's concept of "center of gravity" defined as "the hub of all power and movement, upon which everything depends." However, whereas the older version explicitly stated that centers of gravity existed at all levels of war, the current manual suggests that the concept of center of gravity is useful as an analytical tool only at the operational and strategic levels of war.[1] Why the change?

Unfortunately, the newer manual does not answer this question. As a result, the meaning of center of gravity, as published in FM 100-5, Operations, is ambiguous. Are there "hubs of power and movement" at the tactical level of war? Unless the Army answers this question definitively, the term "center of gravity" will become an establishment "in word."[2] Although no clear meaning of the term is conveyed, everyone will profess to understand what is meant.

Determining if the concept of center of gravity is germane to the tactical level is important for the US Army for two reasons. First, as an analytical tool, tactical level commanders and staffs could use the concept to determine objectives and sequence individual

engagements within a planned battle.

The modern battlefield, extended by the increased lethality, range and mobility of weapon systems is extremely complex. Commanders must husband resources to support sequential and simultaneous combat operations in deep, close and rear areas. Without a focus of effort, tactical leaders may waste forces or improperly position them so they do not favorably influence the battle. Since commanders should direct all energies against the [enemy] center of gravity,[3] it is imperative that they first identify it.

Second, the idea of a tactical center of gravity directly impacts on the validity of the steps of Course of Action (COA) development in the current Military Decision Making Process.[4] At the tactical level, identifying the decisive point(s) is an early step in COA development.[5] However, commanders should not determine decisive points in isolation of centers of gravity; "their relationship is symbiotic; examining one without the other reveals only part of the issue."[6] This linkage suggests that the concepts of center of gravity and decisive point(s) must apply at the tactical level and that the determination of the tactical decisive points first requires the identification of tactical centers of gravity.

This monograph's purpose is to decide if the doctrinal definition of center of gravity, the "hub of

all power and movement, upon which everything depends," is valid at the modern tactical level of war. To do this, the monograph reviews literature to ascertain the intent of the concept developed by Clausewitz in On War. It also examines the intent of Baron Antoine Henri Jomini's concept of "decisive point(s)," in his Summary to the Art of War, because of the relationship between centers of gravity and decisive points -- "decisive points are not centers of gravity; they are the keys to getting at the centers of gravity."[7]

The intent of these authors is the only reliable tool to determine the applicability of their concepts at modern tactical level of war. Since Clausewitz and Jomini, the response to the "military-technical revolution" has dramatically changed the battlefield. Soldiers no longer deploy in dense, shoulder-to-shoulder formations. They go to ground and disperse; the battlefield appears to be "empty."[8] Verbatim translations of Clausewitz's and Jomini's concepts may not fit modern tactical conditions. Therefore, this study evaluates the validity of Clausewitz's and Jomini's concepts at the tactical level by their purport and not by their literal definitions.

If the concepts of center of gravity and decisive points are valid at the tactical level, then this monograph will demonstrate a method to identify them. According to Clausewitz, routine methods are more

appropriate at the tactical level because war at the tactical echelon is relatively more simple than war at the operational and strategic levels.[9] This does not suggest that tactics are simple or easy. Instead, it points out that while strategic and operational commanders concern themselves with the proper use of many instruments of national power, to include military power, tactical commanders are normally only concerned with the employment of the elements of combat power. Specifically, tactical commanders attempt to achieve overwhelming combat power at the decisive point(s) during engagements and battles.[10] What is definitely not simple, is identifying those points.[11]

Comparing friendly and enemy combat power should identify tactical centers of gravity and decisive points.

> **Conclusions [from a relative combat power comparison] consist of an estimate of the general overall relationship of the combat power of his forces to that of the enemy forces, including <u>significant strengths and vulnerabilities</u> [emphasis added].[12]**

However, in the US Army, the problem is choosing the best method to compare combat power. Several scientific models used to correlate forces exist; their primary focus is to provide the commander with a numeric measure of the relative combat strength of

friendly and enemy units. Comparing these measurements provides a force ratio which, when compared to a table of ratios and type missions, identifies the adequacy of the allocated force structure to accomplish the mission assigned.[13] Based on attrition theory, the side with a favorable ratio should be successful.

The problem with these models is that history has provided many examples of units which were successful in battle even though they fought with an unfavorable correlation of forces. Therefore, there must be a better way to measure combat power.

Brigadier General (Retired) Huba Wass de Czege, a former Director of the School for Advanced Military Studies, designed his "Combat Power Framework" to prevent a limited, numeric approach to analyzing fighting strength. His model is an analytical approach which considers all relevant factors affecting combat power. This study uses a matrix based on Wass de Czege's framework to determine centers of gravity and decisive points in two historical tactical operations, the 1939 Battle of Suomussalmi and the 1956 Battle of Abu Ageila. After these demonstrations, this study offers recommendations on the usefulness of the matrix as an aid to determining tactical centers of gravity and decisive points during planning.

II. Tactical Center of Gravity

The US Army's renewed interest in operational art has resulted in many and varied interpretations of the concept of center of gravity. Definitions range from the literal translation borrowed from physics, the point at which all of an object's weight is concentrated, to the most critical vulnerability of a force or nation that when neutralized, will result in the war's end.[14] Coupled with several analogies and other figurative expressions of the concept, the term center of gravity, as used by military professionals, is ambiguous.

This study is concerned with Clausewitz's concept center of gravity because it is his definition which is found in US Army doctrine:

> **The center of gravity is the hub of all power and movement upon which everything depends. It is that characteristic, capability, or location from which enemy and friendly forces derive their freedom of action, physical strength, or will to fight [emphasis added].**[15]

Given the purpose of tactical doctrine is to furnish a basis for prompt harmonious conduct by commanders, staffs and subordinates, a common understanding of Clausewitz's theoretical concept is essential. Therefore, this study examines in depth, the relevance of a tactical center of gravity, as addressed in On

War.

Dr. James Schneider, Professor of Military Theory at the School of Advanced Military Studies, argues that Clausewitz intended the center of gravity to mean where the forces are most densely concentrated. According to Schneider, Clausewitz derives his concept of center of gravity from his description of war as the collision of physical forces to compel others to do ones' will.[16]

Schneider points out that Clausewitz's concept of center of gravity is manifested in his use of the German word *schwerpunkt*. In simplistic terms, *schwer* means heavy and *der punkt*, point.[17] However, "heavy-point" is irrelevant unless aligned with Clausewitz's theory that war is the collision of **physical** forces.

Applying the fundamentals of physics, there cannot be physical force without mass (Force = Mass * Acceleration). Without mass, there cannot be weight, in this case, "heavy." Furthermore, every object has a point at which all of the object's weight may be conceived as being concentrated, where the mass of the object is reduced to a single point -- center of gravity. In symmetrical, uniform objects, the center of gravity and center of mass are the same. In aysmmetrical bodies, the center of gravity is "far from where an observer would intuitively locate it."[18]

With this analogy, the center of gravity of an army or subordinate unit is where the combat force is

most densely concentrated to achieve the effects of mass. Although on a modern "empty battlefield," identifying the center of gravity can be enigmatic, other analogies that extend the concept of center of gravity beyond the physical domain of war are simply stretched too far.[19]

Current German use of the word *schwerpunkt* reinforces Schneider's view. The Germans use it to depict the point of principal effort or "thrust-point," indicating a **concentration of force** aimed against the weakest point of enemy resistance.[20] This thought is consistent with Clausewitz's statement in Book Six of On War,

> **a center of gravity is always found where the mass is concentrated the most densely ...the heaviest blow is struck by the center of gravity. The same holds true in war [emphasis added].**[21]

Clearly the concept of center of gravity, left in its physical realm, is applicable at the tactical level of war. The tactical level of war concerns fighting and "the object of fighting is the destruction or defeat of enemy [forces]."[22] But Clausewitz did not confine his description of center of gravity to purely physical forces. The center of gravity is also contingent upon the cohesion and unity of its parts.[23]

In Clausewitz's era, unity and cohesion of fighting forces was particularly strong. Massed

tactical formations facilitated fire control and superiority and imparted a moral glue that bonded soldiers in the face of danger.[24] At the strategic level, where forces were greatly dispersed, cohesion and unity, "[were] frequently found only in mutual political interests,...usually very loose, and often completely fictitious."[25] Certainly, Clausewitz recognized that many factors influenced the cohesion and unity of forces, and at different levels of war, the factors analyzed varied. Nevertheless, his message was clear. Centers of gravity exist at each level of war.

Conversely, Major Mike Strain, a graduate of the Advanced Military Studies Program, argues Clausewitz's did not intend to apply his concept of the center of gravity to the tactical level. First, Strain identifies that Clausewitz himself appropriately placed the concept of center of gravity in Book VIII, "War Plans."

> **The last book will describe how this idea of a center of gravity in the enemy's force operates throughout the plan of war. In fact that is where the matter properly belongs.[26]**

Second, upon review of Clausewitz's two notes at the beginning of <u>On War</u>, Strain stretches this argument by noting that when Clausewitz wrote Book VIII, he had cleared his mind and truly established the main

features of war.[27] Finally, he adds that in modern war, tactical actions

> **do not of themselves alter the unity and cohesion of the enemy ....only at the strategic and operational levels, are cohesion and unity, centers of gravity, identified, targeted, and destroyed or neutralized.[28]**

One must place Clausewitz's definition of center of gravity found in Book VIII in its correct perspective. Focused at the strategic level, Book VIII is only one part of Clausewitz's compendium on war. While Clausewitz stated that in Book VIII he "hoped to iron out a good many kinks in minds of strategists and statesmen,"[29] he did not void his work on the tactical level of war found in other books. On the contrary, before his untimely death, Clausewitz informed his audience that although he had not yet revised his books, their content was valid:

> **an unprejudiced reader in search of truth and understanding will recognize the fact that the first six books, for all their imperfection of form, contain the fruit of years of reflection on war and diligent study of it.[30]**

Finally, Clausewitz's reference to battle as the center of gravity of war is, as Strain noted, "not inconsistent with the definition of center of gravity found in Book VIII."[31] However, it is not inconsistent because battles were decisive in Clausewitz time,

whereas today, singular battles are not normally decisive. Certainly, Clausewitz witnessed decisive battles of annihilation, but he understood that such battles were not the norm throughout the history of war.

> **Campaigns whose outcome have been determined by a single battle have become fairly common only in recent times, and those cases in which they have settled an entire war are very rare exceptions.**[32]

Clausewitz expressed decisive battle as the center of gravity of war to amplify that battle was the struggle by the **main force**, waged with all available strength.[33] More importantly, decisive battles were not merely reciprocal slaughters aimed at Pyrric victories. They were bloody solutions focused more on killing the enemy's courage.[34] Destroying main effort forces was a way to defeat a cohesive and unified source of power -- a hub of power on which the outcome of any future battles depended.

Conceptually, forces designated as the "main effort" parallels the concept of center of gravity. In current US Army doctrine, this concept is applied even at the lowest tactical levels:

> **[The main effort] is the focus; all other units support the quick success of the main effort. This unit should result in the accomplishment of the commander's mission.**[35]

In choosing the main effort for a given mission, the commander will generally select the best trained and most cohesive unit. He will frequently task organize this force with additional units and designate them to receive priority support from combat and combat service support assets. This added weight makes the main effort a relatively dense concentration of combat power. Thus, the main effort is, in a sense, the "center of gravity" for that mission.

The linkage of center of gravity with the mission's purpose is important. First, this relationship between purpose, objectives and means runs throughout Clausewitz's work.[36] Strategic aims elicit operational objectives and operational aims dictate tactical objectives. At the tactical level, large units determine subordinate unit tasks and objectives, etc..[37] Aims, objectives and tasks are nested.

Second, the center of gravity is derived from the aim at the level at which a plan is made. At each tier, the commander conceptualizes the military design and conditions that ultimately contribute to achievement of next higher's objective. He identifies his most vital source of power as his center of gravity, and assigns it the most critical task neccessary to accomplish the mission. This does not mean the center of gravity will act alone. Instead, it establishes criteria for identifying a valid center of

gravity.

The enemy will often have many strengths, but not all will constitute a center of gravity. For any given mission, the enemy's center of gravity must be that major strength which when destroyed or neutralized, will create a cascading, deteriorating effect on the ability to accomplish the assigned mission. In other words, within the constraints of a mission, if the enemy's center of gravity is not degraded, he can and will continue to resist.

Certainly, the concept of center of gravity is applicable at the tactical level. But is it useful? In "A Guide to the Study of Operational Art and Campaign Design," LTC James Dubik concludes that there may be centers of gravity at each level of war; however, "at any given time, there may not be a center of gravity."[38] He states commanders at each echelon should use Clausewitz's multiple references as a guide to where, when and how to employ forces. For example, if the center of gravity is a tank brigade in assault formation, and that brigade has yet to be deployed, then identifying the absence of a deployed brigade is as instructive as finding one. In its absence, the commander should identify what could become a center of gravity, then preclude it from forming.[39]

Thus, the center of gravity is only a tool for planning."[40] It focuses the synergestic use of combat

power against a single aspect of the foe.[41] It can be defeated directly or indirectly; but, it must be defeated.

In summary, centers of gravity, as Clausewitz intended, are not major weaknesses or vulnerabilities; they are sources of major power determined and limited by cohesion and unity. At each respective level, centers of gravity are the most vital components of an armed nation, field army, or subordinate formation, whose loss or destruction would produce a cascading deterioration of its ability to fight, ultimately leading to complete failure.[42]

At strategic and operational levels, centers of gravity are major sources of political, economic and military power whose cohesion and unity are often determined by public opinion, national will and alliance and coalition structure. At the tactical level, centers of gravity are cohesive combat forces, task organized to best achieve the effect of mass through concentrated combat power. As Clausewitz asserted, they are "where the greatest concentrations of troops are found; the larger the force with which the blow is struck, the surer its effect will be."[43]

III. Decisive Points and Centers of Gravity

> **[O]rders oftentimes ignore the nature of battle because they override the prime fact that action, if it is to be decisive, must develop according to the distribution of enemy forces. That does not imply that one's own force must move by the shortest line straight to the heart of the enemy's area of greatest strength. In most cases it will mean the opposite, with the maneuver evolving around the idea of destroying the heart by pinching off the arteries.**
>
> **SLA Marshall**[44]

Current US Army doctrine inextricably links the concept of decisive point to the concept of center of gravity at the operational level of war. They are not centers of gravity, but are keys to getting at them. Decisive points help commanders gain freedom of *operational* maneuver. They give the *operational* commander the flexibility to select from more than one line of operation for further advance [emphasis added].[45] But, did the theorist Baron Antoine Henri Jomini intend to connect the concept of decisive point(s) to the concept of center of gravity only at the operational level of war?

Jomini never used the term center of gravity in his Summary to the Art of War. Nevertheless, in their analyses, Dr. Schneider and Major Strain agree there is

a complementary relationship between Clausewitz's center of gravity and Jomini's decisive points. To be consistent with the earlier discussion on center of gravity (Section II), this study examines both viewpoints. But first, it reviews what Jomini stated.

Jomini emphatically defined the underlying principle of war in four maxims. First, strategic movements must aim to throw the mass of the army successively upon decisive points and also upon the enemy's lines of communications without compromising his own. Second, the commander must engage small portions of the enemy with the bulk of his forces. Third, the commander must mass his force on the battlefield against the decisive point. Fourth, the commander must engage the decisive point at the proper time and with ample energy.[46]

Jomini then provided several definitions of decisive points. Like Clausewitz's descriptions of center of gravity, Jomini pointed his definitions in many directions to develop his concept.

Jomini illustrated two basic categories of decisive points: geographic and maneuver. Centers of communication, key terrain features and fortifications can be geographic decisive points. At the operational level, they "are capable of exercising a marked influence upon the result of a campaign or single enterprise."[47] For example, in March 1945, the

Ludendorf Bridge at Remagen was a decisive point. The siezure of the bridge allowed the U.S. First Army to rapidly move across the Rhine River. It was a great advantage to the Allied Armies as they attacked Germany.

Commanders determine maneuver decisive points by comparing the positional relationship between friendly and enemy forces. They conduct operations against these points to easily separate the enemy from his base of support, while simultaneously ensuring friendly lines of communication are not exposed. Generally, the decisive point of maneuver is the enemy flank.

On the battlefield, Jomini offered three factors that determine the decisive point(s). Commanders must consider the terrain, the disposition of combat forces, and the relationship of these to the desired end-state. For any situation, there may exist more than one decisive point. Therefore, depending upon the object of the campaign or battle, be it offensive or defensive, the commander must choose which decisive point(s) will most likely guarantee success. These should be labeled "objective points."[48]

Inauspiciously, some of the decisive points that Jomini illustrated bear resemblance to Clausewitz's descriptions of centers of gravity found in Book VIII of On War. Capitals are centers of gravity because they are seats of power and government and often

centers of communication -- "hubs of power." Since their protection or seizure would markedly influence the outcome of a campaign, they are also decisive points. But current US Army doctrine states that a center of gravity cannot be a decisive point.[49] What then is the relationship between decisive points and centers of gravity?

According to Dr. Schneider, one thread that stiches the two concepts together is the principle of concentration. By concentrating forces, commanders can achieve the effect of mass. "In tactics, as in strategy, superiority of numbers is the most common element in victory."[50] Absolute superiority of forces is not necessary as long as relative mass is attained at the decisive point.[51]

During Clausewitz's era, commanders best achieved the effect of mass through the physical concentration of infantry, artillery and cavalry. By concentrating, the aggressor generated superior combat power relative to an enemy's weak point or vulnerable flank. He attacked against that point to destroy the enemy. Conversely, the defender attempted to maneuver to concentrate his forces at that point to match the attacker's thrust.

Thus, Jomini's concept of decisive point is linked to Clausewitz's concept of center of gravity. Where Jomini asserted that the underlying principle of war is

to mass forces against the decisive point, he did, in a sense, state that the center of gravity should be placed at the decisive point.

Schneiders' description of decisive points represents the second thread that weaves the two concepts together. In any battle, there are physical, cybernetic, and moral points of vulnerabilty that can decidely impact the outcome of the action.[52] At the tactical level, the loss, damage or destruction of these points reduces the cohesion and unity of fighting forces; hence, their will to resist dwindles.[53] To guarantee success at these points, the surest bet is to attack or defend them with overwhelming concentrations of combat power -- centers of gravity. Thus, the seam between centers of gravity and decisive points is sewn.

Major Strain also linked the concepts of center of gravity and decisive points together. With the wagon wheel and spoke analogy, he determined that

> **success at decisive points results in indirectly attacking the enemy's center of gravity through the massing of overwhelming combat power against a vulnerability, gaining success against an enemy strength through indirect means.[54]**

Decisive points exist at all levels of war. Commanders focus combat power at these points to achieve success in battles and engagements, which ultimately support the attainment of operational and

strategic objectives. These decisive points are translated into tactical objectives at the operational and strategic levels.

However, when Strain basted the concepts of decisive points and centers of gravity, he modified Clausewitz's definition of center of gravity, associating it with a time dimension. Centers of gravity are stable, cohesive sources of strength. They exist only at strategic and operational levels and become the focus of all operations. Rapid changes in focus at the tactical level make identifcation of centers of gravity too difficult. Therefore, they do not exist.[55]

Applying the same logic, determining decisive points in today's dynamic tactical environment is also arduous. Since, the increased pace of operations does not invalidate the presence of tactical decisive points, it should not annul the concept of tactical centers of gravity. Furthermore, Clausewitz did not define center of gravity in terms of time. Yet in light of the situation, he did suggest that commanders should consider the advantages or disadvantages of time to determine the best use of the center of gravity.[56] Thus, the stability of focus that Strain mentions is more a function of the correct and timely identification of enemy centers of gravity and decisive points during planning.

In summary, at all levels of war there are physical, moral, and cybernetic vulnerabilites that when destroyed or neutralized result in the waning of the will to resist. These vulnerabilities have a significant impact on the outcome of the battle, campaign, and war. As analytical planning tools, decisive points help to focus the efficient application of combat power ultimately targeted at the destruction or neutralization of enemy centers of gravity. If the center of gravity is indeed the strong heart of the enemy, then decisive points are the heart's exposed arteries.

IV. Combat Power Comparisons: Determining Tactical Centers of Gravity and Decisive Points

> **Relative superiority, that is, the skillful concentration of superior strength at the decisive point, is much more frequently based on the correct appraisal of this decisive point, on suitable planning from the start.**[57]

Current doctrine recognizes the importance of achieving superior strength at the decisive point. What is not clear is how to measure that strength and how to determine that point. At the tactical level, can a comparison of strength between two opposing forces identify decisive points and centers of

gravity?

The number of personnel and machines at a critical point in an engagement is only one measurement of strength that determines success. Generally, physical superiority is a fundamentally sound concept. However, it must be great enough to counterbalance all other factors influencing that engagement.[58] These factors are accounted for in the term combat power.

Commanders create effective combat power by combining the elements of maneuver, firepower, protection, and leadership. They convert the potential of forces, resources and opportunities into actual fighting strength, ideally applied at the decisive point(s). These combat power elements are dynamic and interactive. Leadership is the most essential element because it converts force potential into capability by inspiring soldiers with the will to win.[59]

There are several methods to measure combat power. The most common forms are: the bean count, subjective values and objective values.[60] The bean count simply enumerates the number of systems on hand. This method fit well during Clausewitz's era. The general rule that more was better stemmed from the relative equality in military technology during the eighteenth century.

Using subjective values, commanders measure combat power against a weapon system or unit that is normalized. From this base weapon or unit, relative values are subjectively assigned to comparable systems or units. The reliability and accuracy of information to make this subjective assessment is critical to the validity of the method.

Finally, the objective value method attempts to precisely quantify "the worth" of a weapon system or unit. Using this method, most models quantify an individual weapon system's lethality based on historical and experimental data. Some models include coefficients to account for environmental and operational factors that could influence that systems lethality. Theoretically, through complex mathematical formulas, the outcome of a battle can be determined.[61]

Each of the methods listed above have relative advantages and disadvantages. The bean count and subjective value methods are simple, but lack the detail necessary to provide an accurate measurement. The objective method, while potentially accurate, is complex and difficult to implement at the lowest tactical levels. All methods generate a numerical force ratio when the combat power of friendly and enemy forces are compared. However, these ratios are only a start point, giving only a general idea of

what might be possible based on historical precedence. A superior force ratio is only an advantage if skillfully employed.[62]

A better method to facilitate the effective and efficient employment of available combat power is to completely familiarize oneself with all the aspects of the enemy and friendly situation. Mechanical selection of schemes of maneuver based on set rules or plays must be avoided. Instead, combat power should be applied subjectively to correspond with the actual, objective situation.[63] Any analytical method designed to facilitate the best application of combat power against the decisive point, should consider both objective and subjective factors particular to a given situation. Similarly, determining the decisive point(s) requires a subjective evaluation of the same factors.

Huba Wass De Czege's combat power framework is a method of analysis designed to consider all factors that can influence the effect of combat power in a modern, complex and lethal tactical environment. Wass De Czege opposes the mechanical selection of schemes of maneuver based on a few simple decision rules, simple "bean counting," or upon the intuitive understanding of a few individuals. His approach considers all variables that can influence the elements of combat power. It is reduced to a single

equation:

Friendly Enemy
L(F+M+P-D) - L(F+M+P-D) = The Outcome of Battle.

L - Leadership Effect
F - Firepower Effect
M - Maneuver Effect
P - Protection Effect
D - Opposing Force Degradation of F,M,P[64]

In the equation above, each factor represents a function of many variables (Appendix A) which can expand or contract based upon the situation and the time available to consider them. The model is reliable as long as the data input is accurate.

Ostensibly, the model appears simple, but as Wass de Czege admits, it is a "complex function," a rigorous methodology.[65] This study demonstrates a more simple method to compare combat power based on Wass De Czege's model and uses it to determine tactical decisive point(s) and centers of gravity. This method is intended to supplement the Military Decision Making Process. It builds upon the Intelligence Preparation of the Battlefield (IPB) process and the Command Estimate Process.

The Combat Power Matrix

As a reminder, decisive points are vulnerabilities that when destroyed or neutralized will

ultimately result in the destruction of the enemy's center of gravity. Tactical level centers of gravity are normally major sources of combat power capable of accomplishing the most vital tasks within an assigned mission. The identification of enemy centers of gravity and decisive points serve as planning tools to efficiently synchronize the effects of friendly combat power to accomplish the mission. They must be determined before developing courses of action.

The combat power comparison matrix is an analytical approach to identify centers of gravity and decisive points. It is based on deductive reasoning on the premise that superior combat power at the decisive point will lead to tactical success. For any situation, the conclusion must answer the questions, where, when and how can superior combat power be achieved? Of course, combat power is relative because the enemy always has a vote.

Before the matrix can be used, commanders and staff members must develop their planning estimates and analyze the factors of METT-T to derive friendly capabilities and limitations. The intelligence officer integrates the IPB process and attempts to determine the enemy's greatest strengths and weaknesses. This is an important point. More strengths and weaknesses do not necessarily lead to a better analysis; they may even cause a loss of focus.

Commanders must decide which strengths and weaknesses are the most pertinent based on their knowledge of the situation and their experience. The next step is to use the combat power matrix (Table A) to determine the decisive points and centers of gravity.

COMBAT POWER COMPARISON MATRIX

	FRIENDLY	ENEMY	SIGNIFICANT FACTORS
FIREPOWER	+ -	- +	?
MANEUVER	+ -	- +	?
PROTECTION	+ -	+ -	?
LEADERSHIP	+ -	- +	?

TABLE A

The purpose of the matrix is to organize the greatest strengths and weaknesses, derived during estimate process, into some useful format. Within each element of combat power, the object is to pair friendly strengths (+) with enemy weaknesses (-). At the same time, commanders should list friendly vulnerabilities to ensure force protection is built

into the plan. Commanders must also conduct comparisons between different elements of combat power (friendly firepower vs. enemy maneuver, etc.) because the elements are interactive.

Analysis of the strengths and vulnerabilites with regard to the specific mission assigned is the next step. Commanders should label as "centers of gravity," those strength(s) which decisively contribute to mission accomplishment and, if destroyed or neutralized would cause a torrential deterioration, ultimately resulting in mission failure. Likewise, commanders should label those vulnerabilities that if attacked would result in a significant degradation of the center of gravity's ability to support the accomplishment of the mission, as "decisive points."

Finally, from this comparison, the commander must determine how he can achieve overwhelming combat power against either the center of gravity or any one of the decisive points. These ways are labeled signifcant factors. Ideally, commanders should develop plans to apply overwhelming combat power directly against the enemy center of gravity. However, if enemy and freindly combat power is relatively equal, or if friendly combat power is inferior, then commanders should develop plans to defeat the opponent's center of gravity by applying

pressure at decisive points. Two historical examples will help illustrate this subject.

Suomussalmi, 1939-1940

On 30 November 1939, Soviet Russia violated a Non-Aggression Treaty and attacked Finland. In *blitzkrieg* fashion, Stalin launched four Soviet armies across the territorial boundaries to crush the "Finnish Reactionaries" opposed to his Communism.[66] Soviet leadership expected victory in four to five days, and at the very worst, twelve days.[67] What Stalin failed to understand, however, was that "Finland preferred...to die fighting rather than to accept the consequences of aggression."[68]

From the beginning, there was little possibility that the Finns could win strategically without the support of Western nations.[69] The Soviets had thousands of modern tanks and armored cars, and could muster 800 aircraft against the Finns' 28 Renault tanks and 150 planes. Strategic manpower resources favored the Soviets 40 to 1.[70] There was no surprise that after the first week of war, Finnish troops were on the verge of collapse, defeated and demoralized by the appearance of Soviet tanks rumbling through their frontier zone.

But, the Finns regained their composure and in

an epic struggle for survival, they courageously defended their homeland for the next hundred days. During this fight, the battle of Suosmussalmi stands out. Inferior in numbers, firepower and material, the Finnish 9th Infantry Division destroyed the Soviet 163rd and 44th Motorized Rifle Divisions.

Located in a coniferous forest, Suomussamli sits along the path to the strategic crossroads of Puolanka.[71] Two narrow roads lead from Russia to Suomussamli. Between 7 December 1939 and 8 January 1940, the time of the battle, the temperature averaged 30 to 40 degrees below zero Fahrenheit. Frozen lakes could support troops and the snow varied from three to four feet in depth.[72]

On 7 December, the Finnish 27th Infantry Regiment, with less than five thousand soldiers, blocked the advance of the Soviet 163rd Division at Suomussalmi until the arrival of reinforcements. On 25 December, the strengthened 27th Regiment, newly designated the 9th Division, counterattacked the Soviet 163rd Division as they sat idle on the roads. Meanwhile, tanks and infantry from the elite Soviet 44th Division moved to reinforce.

The Finns needed to prevent the 44th Division, the Soviet's tactical center of gravity, from linking up with the 163rd Division. Analysis of the four factors of combat power illustrates that for the

Finns the best defense was an aggressive offense (Appendix B). Only by conducting ambushes and limited attacks could they achieve relative superiority against the Soviet decisive points.

The major Soviet weaknesses reflected their lack of preparation for the harsh arctic conditions encountered. First, the Soviets were road-bound. Soviet doctrine was based on maneuver in the open Ukrainian landscape, not in snow covered forests. Although they had skis, their soldiers were not trained in their use.[73] Infantry moved no more than 400 yards off the roads and primitive snow plows could not penetrate deep snow to push the tanks forward.[74] Second, Soviet soldiers were ill equipped. Clothing provided neither warmth or camouflage and they had few tents and stoves to shelter them from the severe temperatures.[75] Finally, the Soviets had only one line of communication and this "was, of course, known in its totality to the Finns."[76]

On the other hand, the Russians received support from Air Force bombers. They had tanks and outnumbered the Finns at least three to one. Russian division artillery firepower was about three times that of the Finnish and they had twice as many machine guns.[77]

In contrast, the Finns greatest combat strength was their mobility and the ability to maneuver. They

were excellent skiers and orienteers. Additionally, they were familiar with the terrain and equipped to operate in the extreme weather.[78]

The Finns determined that the Soviets were most vulnerable while stopped along the road at night. Using their ski mobility advantage, they employed *Motti* tactics which can be described in three phases.[79] First, they built ice roads parallel to the major Soviet routes, reconnoitered the advancing divisions, and stopped them at well chosen points along the road. Second, they attacked the halted columns along their flanks and cut them into small piles -- like making logs of firewood from a tree. During this phase, they deliberately sought out field kitchens as targets. Experience had shown them that without warm food, soldiers would grow physically weaker and more psychologically demoralized.[80] Finally, the isolated and disheartened enemy was annihilated by raids and deliberate attacks.

Clearly, the Finns' tactical center of gravity was their ability to maneuver in the snow covered forests. They did not choose to build static battle positions because these were extremely vulnerable to the effects of overwhelming firepower, the Soviet center of gravity. Therefore, they attacked the advancing Soviet Division at its decisive point -- at night while stalled along the road. Through a

well reasoned analysis of all factors of combat power, the numerically inferior Finns were able to achieve relative combat power superiority against the Soviets. In the end, the Russians learned hard lessons from Suomussamli and "eventually did what they should have done at the beginning of December; they settled down to the blasting of a sector of the Isthmus defenses"[81] and followed with overwhelming ground combat forces. They more effectively used their enormous firepower advantage and accomplished the mission.

Abu Ageila, 1956

In 1956, Israel perceived the absorption of Soviet weaponry into Egyptian armed forces as a threat to their state security. Likewise, Egyptian nationalization of the Suez canal, on 27 July 1956, threatened a major economic artery of France and England. To reduce these threats, France, England and Israel agreed to jointly attack Egypt. On 29 October 1956, *Operation Kadesh* began with an Israeli airborne insertion into the Mitla Pass that ostensibly threatened the Suez Canal. This calculated move politically justified France's and Britain's assault to secure the northern Suez (*Operation Musketeer*).[82] The Israelis then attacked to eliminate the threat of Egyptian forces located in

the Sinai and to secure sea lines of communication into Eilat, Israel.

The success of *Operation Kadesh* depended upon the swift seizure of Abu Ageila. This critical piece of terrain straddled the junction of three major roads linking Israel with the Suez and was defended by Egyptians.[83] Time was a also major operational constraint for the Israeli's. The Israelis had to sieze Abu Ageila quickly to facilitate the rapid and synchronzied movement of forces toward the Suez or the attack would stall.[84]

Similarly, the retention of Abu Ageila was key to the Egyptian defense of Sinai. Like an anvil, forces at Abu Ageila were to block a westward Israeli advance for two to three days, while heavy armored formations first concentrated at Bir Gifgafa and Bir al Thamada and then hammered the Israeli southern flank.[85] If Abu Ageila was not controlled, the Egyptians' ability to defend the Sinai would be seriously jeopardized.

Responsibility for the static tactical defense of Abu Ageila rested with Brigadier Yassa Boulous, Commander, 6th Infantry Brigade, 3rd Infantry Division. Boulous built an intricate defensive network around his 17th and 18th Infantry battalions, the 3rd Field Artillery Regiment, the 94th and 78th Antitank Batteries, a jeep mounted reconnaissance company and two reserve companies.[86] Referred to as a "hedgehog," the Egyptians fortified three sand

ridges. Each position, fixed with deep walled trenches, bunkers and minefields, could observe at least two other positions. The main position, located on the dominant Umm Qatef Ridge, overlooked the entire complex with visibility measured in miles. Forward deployed forces observed Israeli movements to provide early warning and determine their size. One infantry company, reinforced with an antitank battery, was in general reserve approximately 5 km rearward.[87]

Opposing Boulous' 6th Brigade, was Colonel Wallach's Central Task Group, 38th *Ugdah*. Wallach was to destroy the Egyptians at this road block in order to facilitate the resupply of 7th Armored Brigade and 202d Paratroop Brigade. His units included the 4th and 10th Infantry Brigades, the 7th Armored Brigade, three batteries of heavy artillery, one battery of medium artillery and one company of engineers. The 37th Mechanized Brigade was also available if needed.[88]

The battle for Abu Ageila began on October 30th and lasted for three days.[89] As planned, Wallach's 4th Brigade initiated a dismounted assault against several Egyptian outposts, but, found them unoccupied. Meanwhile, tanks from the 7th Armored Brigade prematurely attacked another forward location at Kusseima. This action alerted the Egyptians of the impending armored attack and they reinforced their defense. Since secrecy was lost, the Israeli

assault against Boulous' fortress at Umm Qatef was initiated without delay.[90]

As the battle unfolded, the Israelis piecemealed units against the defenses at Umm Qatef and were quickly repulsed. Additionally, elements of the 7th Brigade were diverted to the southwest, bypassing Umm Qatef where they were badly needed. Fortunately, 7th Brigade reconnaissance elements discovered that Daika Pass, a defile leading to the rear of Abu Ageila, was damaged but unguarded.

News of the Daika Pass finding hastened the encirclement of the Abu Ageila complex. At night, while other task forces established positions to block expected Egyptian counterattacks, an armored task force from the 7th Brigade infiltrated the defile, seized the key crossroads at Abu Ageila, and cut the Egyptian supply route from the Suez.

Although secured, Daika Pass would not support wheeled vehicles; the Israelis had to destroy the Egyptians straddling the hard surfaced road to continue the attack west.[91] They assaulted the Abu Ageila positions from both the west and east. For the next day and a half, tanks and infantry conducted uncoordinated attacks against the Raufa Dam and Umm Qatef positions but the Egyptians blunted these assaults and retained the key terrain.

On 31 October, as the Israeli's continued their attack against Abu Ageila, French and British bombers destroyed many Egyptian aircraft near the Suez. This

generated fear of an immediate invasion of the canal in the Egyptian high command. In response to this fear, the Egyptian leadership directed the withdrawal of forces in the Sinai to the west bank of the Suez. By late morning of 1 November the 6th Brigade at Abu Ageila exfiltrated their positions. Finding Abu Ageila abandoned, the Israelis occupied it on 2 November.

At the operational level, Abu Ageila was clearly a decisive point for both Egyptians and Israelis. Its control provided for the flexible and synchronized maneuver of armored and mechanized forces which were the centers of gravity for both sides. Without Abu Ageila, the ability of both forces to accomplish assigned operational objectives was seriously degraded. Appropriately, both sides weighted the control of Abu Ageila in their plans.

At the tactical level, a comparison of available combat power identified similar decisive points and centers of gravity (Appendix B). The center of gravity for Boulous' 6th Brigade was his main position on the dominant Umm Qatef Ridge. Troops were trained and disciplined, leaders were familiar with the terrain and their men, weapons were sighted, explosives were emplaced, and Bolous had latitude to demonstrate initiative.[92] Only from here could the Egyptians block the Israeli advance along the critical hard surface road long enough for armored reinforcements and supplies to arrive from Suez.

Boulous's defenses were not flawless. They had significant vulnerabilities -- decisive points. The explosives in the Daika Pass were insufficient to create a crater large enough to prevent an Israeli route to the rear of Abu Ageila.[93] The Egyptians were also dangerously low on provisions, and it is doubtful they could have held out much longer.[94]

In comparison, the Israelis started the attack with a marked advantage in firepower and manpower: 100 Israeli tanks against 22 Egyptian self propelled guns; 12,000 Israeli soldiers versus the 6th Brigade's 3000.[95] For reinforcements, the Israelis could depend upon the 37th Mechanized Brigade, whereas Bolous could only receive help from the 4th Infantry Brigade and its two to three tank companies located 40 km to his northwest.

Unfortunately, the Israelis failed to effectively synchronize their overwhelming firepower, their center of gravity, against the Abu Ageila fortress. Hastily piecemealing their forces, even after securing the critical Daika Pass, resulted in their failure to achieve the effect of mass. By not massing, the Israelis were unable to rapidly seize the critical road system and were becoming increasingly more vulnerable to expected Egyptian counterattacks. Luckily for the Israelis, these attacks did not materialize.

Two key vulnerabilities directly contributed to the degradation of the Israeli tactical center of

gravity. First, "doctrinal ambiguity over the roles of armor and infantry...resulted in confusion regarding how to defeat the Egyptians."[96] Second, operational security constraints prevented the tactical synchronization of tank and infantry forces at the beginning of the battle.[97] It would be fallacious to argue that the Egyptians knew of these Israeli vulnerabilities, considered them as decisive points, and planned to capitalize on them. In this case, they were lucky. As the events made evident, the Israelis exploited them.

In summary, both examples demonstrate the usefulness of the Combat Power Comparison Matrix. Using other methods of comparison which provide only a numeric measure of relative strength, the Russians and Israelis should have won decisively. They did not. On the other hand, the matrix arrayed the major enemy strengths and weaknesses of both forces, many of which could not be quantified, into a simple format that made it easy to compare them. Analysis of these comparisons resulted in the identification tactical centers of gravity and decisive points. Had the Russians and Israelis used these points during planning, they might have developed more feasible tactical plans and won.

V. Conclusion

The current FM 100-5, Operations' use of

Clausewitz's concept of center of gravity, the "hub of all power and movement upon which everything depends," is not sufficiently definitive to guide the specific actions of tactical commanders. Likewise, the manuals definition of decisive points is somewhat misleading. Clearly, both concepts are relevant at the modern tactical level of war.

Tactical centers of gravity are major strengths whose application has direct and significant influence on the outcome of an assigned mission. The destruction or degradation of a center of gravity ultimately results in mission failure and the will to continue to resist is subdued.

At each echelon, tactical plans should ultimately aim at the destruction of enemy centers of gravity. This is the surest way to success. Unfortunately, the lethality of modern weapons, the extended battlefield and the fluid nature of combat, normally makes direct attacks against enemy centers of gravity economically unfeasible. Plans should be developed to apply overwhelming combat power against enemy decisive points, thus acquiring a marked advantage by indirectly weakening the opponent's center of gravity.

As analytical tools, the concepts of center of gravity and decisive points help tactical commanders efficiently synchronize combat power. The difficulty

is determining these points. This study illustrates that an analytical comparison of the factors of combat power is useful in identifying tactical centers of gravity and decisive points.

The Combat Power Comparison Matrix organizes information into a simple format making it easier to analyze the dynamic interaction of several combat power factors, many of which cannot be quantified. Through analysis of these comparisons, commanders can identify tactical centers of gravity and decisive points. Like any other model, the effectiveness of the Combat Power Comparison Matrix relies upon the accuracy of the information used. Good intelligence is the key. Nevertheless, commanders must consider all variables effecting combat power and determine centers of gravity and decisive points before they develop tactical plans.

Thus, when rewritten, FM 100-5, Operations should extend the relevance of Clausewitz's concept of center of gravity and Jomini's concept of decisive points to the tactical level. Other manuals which state commanders should determine decisive points during COA development, but do not explain the concept, also need revision. Finally, the Army should update its tactical manuals to illustrate methods that can help commanders determine decisive points and centers of gravity.

VI. Endnotes

1. U.S. Army, Field Manual (FM) 100-5, Operations, (Washington, DC: Headquarters, Department of the Army, 1993), p. 6-7.

2. Donn A. Starry, "Operational Concepts and Doctrine," in "Commander's Notes...No. 3," reprinted for use by John L. Romjue, "From Active Defense to Airland Battle: The Development of Army Doctrine 1973-1982," (Fort Monroe, Virginia: Historical Office, United States Army Training and Doctrine Command, 1984), p. 87. Starry defines "in word."

3. Carl von Clausewitz, On War, ed. and translated by Michael Howard and Peter Paret, (Princeton, NJ: Princeton University Press, 1976), p. 596.

4. For a discussion of the Military Decision Making Process see U.S. Army, Field Manual (FM) 101-5, Staff Organization and Operations, (Washington, DC: Headquarters, Department of the Army, 1984), p. 5-4-5-11.

5. U.S. Army, Field Manual 7-10, The Infantry Rifle Company, (Washington, DC: Headquarters, Department of the Army, 1990), p. 2-25, and U.S. Army, Field Manual 7-20, The Infantry Rifle Battalion, (Washington DC: Headquarters, Department of the Army, 1992, p. 2-17, and US Army Command and General Staff College, Student Text 100-9, The Tactical Decision Making Process, (Fort Leavenworth, KS: USACGSC, 1993) p. 4-2.

6. Patrick M. Strain, "Tactical Centers of Gravity: Fact or Fallacy?" Monograph, US Army Command and General Staff College School of Advanced Military Studies, (Fort Leavenworth, KS: USACGSC, 1993), p. 3.

7. U.S. Army, FM 100-5, Operations, 1993, p. 6-8.

8. Richard E. Simpkin, The Race to the Swift: Thoughts on Twenty First Century Warfare , (Virginia: Pergamon-Brassey's International Defense, 1985), p. 1-18, and James J. Schneider, "Vulcan's Anvil: The American Civil War and the Emergence of Operational Art," Theoretical Paper No. 4, U.S. Army Command and General Staff College School of Advanced Military Studies, (Fort Leavenworth, KS: USACGSC, 1991), p. 6-14 as noted in Gordon R.

Sullivan and James M. Dubik, "Land Warfare in the 21st Century," Military Review, Volume LXXIII, 9 (June 1993), p. 22.

9. Clausewitz, p. 151-155.

10. Clausewitz, p. 153, and U.S. Army, FM 100-5, Operations, 1993, p. 6-3. Although Clausewitz does not use the term "combat power," he discusses the use of tactical princples with respect to the use of firearms, artillery and cavalry. FM 100-5, Operations defines tactics as the "art and science of employing available means to win battles and engagements."

11. Anotine Henri Jomini, Summary to the Art of War, ed. by J.D. Hittle in Roots of Strategy, Book 2, (Harrisburg, PA: Stackpole Books, 1987), p. 461.

12. U.S. Army, Field Manual 101-5, Staff Organizations and Operations, (Washington DC: Headquarters, Department of the Army, 1984), p. E-4.

13. U.S. Army Command and General Staff College, Student Text 100-9, The Tactical Decision Making Process, p. 2-3-2-6.

14. Robert R. Leonhard, The Art of Maneuver, (Novato, CA: Presidio Press, 1991), p. 20-21.

15. U.S. Army, FM 100-5, Operations, 1993, p. 5-6.

16. Schneider, "Vulcan's Anvil: The American Civil War and the Emergence of Operational Art," p. 25-26.

17. Strain, p. 5.

18. J. E. Williams, et al., Modern Physics (1984) found in Multimedia Encyclopedia, Version 1PB (Grolier Inc. 1992)

19. James J. Schneider and Lawrence L. Izzo, "Clausewitz's Elusive Center of Gravity," Parameters, (September 1987) p. 48.

20. John A. English, A Perspective on Infantry, (New York, NY: Praeger Publishers, 1981), p. 93, and Strain, p. 5.

21. Clausewitz, p. 485.

22. Ibid., p. 227.

23. Ibid., p. 486.

24. James J. Schneider, "Theory of the Empty Battlefield," in RUSI Journal, September 1987, p. 42.

25. Clausewitz, p. 486.

26. Ibid., p. 486.

27. Strain, p. 10-11.

28. Ibid., p. 9.

29. Clausewitz, p. 70.

30. Ibid., p. 70.

31. Strain, p. 8-9.

32. Clausewitz, p. 260.

33. Ibid., p. 248.

34. J.F.C. Fuller, The Conduct of War, (New York, NY: Da Capo Press, Inc., 1992), p. 73.

35. U.S. Army, Field Manual 7-10, The Infantry Rifle Company, p. 2-6.

36. Peter Paret, "Clausewitz," ed. by Peter Paret in Makers of Modern Strategy, (Princeton, NJ: Princeton University Press, 1986), p. 207. Throughout hids book, Clausewitz illustrates that ultimately, the defeat of enemy forces is the primary purpose tactical operations. This study has shown that units designate main effort forces to accomplish the most important task necessary to defeat the enemy; hence, the concepts of main effort and mission purpose are linked.

37. William W. Mendel and Lamar Tooke, "Operational Logic: Selecting the Center of Gravity," Military Review, Volume LXXIII, No. 6, June 1993, p. 5.

38. James M. Dubik, "A Guide to the Study of Operational Art and Campaign Design," Suggested Draft, 1991, p. 12, reprinted for use in U.S. Army Command and General Staff College School of Advanced Military Studies, Course Readings Campaign Planning Part I:

Introduction, (Fort Leavenworth, KS: USACGSC, 1993), p. 12.

39. Ibid., p. 12. This example was modified by specifiying a type unit.

40. Charles R. Viale, " A Conversation at the Club [:] Another Analysis of the Concept of Center of Gravity," Monograph, (Fort Leavenworth, KS: U.S. Army Command and General Staff College Schoolof Advanced Miltary Studies, 1988), p. 11.

41. Mendel, p. 4.

42. U.S. Army Field Manual 100-5, Operations, (Washington, DC: Headquarters, Department of the Army, 1986), p. 179.

43. Clausewitz, p. 485.

44. S.L.A. Marshall, Men Against Fire: The Problem of Battle Command in Future War, (Gloucester, MA: Peter Smith, 1978), p. 106.

45. U.S. Army, FM 100-5, Operations, 1993, p. 6-8.

46. Jomini, p. 486.

47. Ibid., p. 487.

48. Ibid., p. 468.

49. U.S. Army, FM 100-5, Operations, 1993, p. 6-8.

50. Clausewitz, p. 194.

51. Clausewitz, p. 196.

52. James J. Schneider, "The Theory of Operational Art," Theoretical Paper No. 3, U.S. Army Command and General Staff College School of Advanced Military Studies (Fort Leavenworth, KS: USACGSC, 1988), p. 28-29.

53. James J. Schneider and Lawrence L. Izzo, "Clausewitz's Elusive Center of Gravity," Parameters, September 1987, p. 57-58.

54. Strain, p. 16.

55. Ibid., p. 24.

56. Clausewitz, p. 596-597.

57. Ibid., p. 197.

58. Ibid., p. 194.

59. U.S. Army, FM 100-5, Operations, 1993, p. 2-9-2-11.

60. Dave Hogg, "Correlation of Forces: The Quest for a Standardized Model," Monograph, (Fort Leavenworth, KS: U.S. Army Command and General Staff College School of Advanced Military Studies, 1993), p. 7-9.

61. Trevor N. Dupuy, Numbers, Predictions and War[:] The Use of History to Evaluate and Predict the Outcome of Armed Conflict, (Fairfax, VA: Hero Books, 1985). Dupuy discusses the Quantified Judgement Method of Analysis (QJMA). This is a complex mathematical approach requiring computer assistance.

62. Clausewitz, p. 197.

63. Mao-Tse Tung, Selected Military Writings of Mao Tse-Tung, (Peking: Foreign Language Press, 1972), p. 85.

64. Huba Wass De Czege, "Understanding and Developing Combat Power," Monograph, (Fort Leavenworth, KS: U.S. Army Command and General Staff College School of Advanced Military Studies, 1984), p. 10.

65. Ibid., p. 3, 10.

66. Allen F. Chew, The White Death: The Epic of the Soviet-Finnish Winter War, (Michigan State University Press, 1971), p. 2-6.

67. Ibid., p. 20.

68. John Langdon-Davies, Invasion in the Snow, (Boston, Houghton Mifflin Co., 1941), p. 6.

69. Ibid., p. 5-6.

70. Chew, The White Death, p. 23-24.

71. Chew, The White Death, p. 97. Puolanka lies midway between the Soviet border and Oulu. The latter is a key railroad

junction linking Finland with Sweden; its control is critical for the transport of reinforcements and supplies.

72. Suomalainen, Victor, "The Battle for Suomussalmi," Canadian Military Journal, (Date Unknown), p. 22.

73. Langdon-Davies, p. 18-29. The Finns found thousands of copies of the *Russian Manual of Ski-Fighting*, dated November 1939 discarded at Suomussalmi. Interestingly, the author points out that the manual was compiled by a pure theoretician who showed no signs of having worn his skis with the purpose of fighting in mind.

74. Suomalainen, p. 26.

75. Langdon-Davies, p. 16-17.

76. Ibid., p. 51.

77. Suomalainen, p. 22, and Thomas B. Nelson and Hans B. Lockhoven, The World's Submachine Guns, (Alexandria, VA: TBN Enterprises, 1963), p. 536, 591-593. The Finnish 9mm, Suomi Model M/1931 Machine Pistol was qualitatively equal to the Soviet 7.62mm PPD 1934/38 machine pistol. Both fired 800-900 RPM, each weapon's maximum effective range was 500 m, and both could carry 20-71 round magazines or drums.

78. Ibid., p. 15-51. The Finns were excellent skiers; they were equipped with the "Suomi" automatic machine pistol which was ideal for forest fighting; they had camp stoves and tents to shelter them from the cold. They wore white over-garments for camouflage.

79. U.S. Army Infantry School, "Motti Tactics," Infantry Journal, January 1950, p. 9.

80. Allen F. Chew, "Fighting the Russians in Winter: Three Case Studies," Leavenworth Paper No. 5., U.S. Army Command and General Staff College Combat Studies Institute, (Fort Leavenworth, KS: USACGSC, 1981), p. 25.

81. Langdon-Davies, p. 106.

82. Trevor N. Dupuy, Elusive Victory, (Fairfax, VA: Hero Books, 1984), p. 136-143.

83. George W. Gawrych, "Key to the Sinai: The Battles for Abu Ageila in the 1956 and 1967 Arab-Israeli Wars," Research Survey No. 7, U.S. Army Command and General Staff College Combat Studies Institute, (Fort Leavenworth, KS: USACGSC, 1990), p. 3, 6, 9 and Dupuy, Elusive Victory, p. 157, and Chaim Herzog, The Arab Israeli Wars, (New York, NY: Random House Inc., 1984), p. 114-115, 123.

84. Gawrych, p. 6.

85. Ibid., p. 8.

86. Dupuy, Elusive Victory, p. 158.

87. Dupuy, Elusive Victory, p. 158-159, and Gawrych, p 13-18, and S.L.A. Marshall, Sinai Victory, (Nashville, TN: The Battery Press, 1985), p. 94-97. Note. There is dispute as to whether the positions had interlocking fires. According to Gawrych, mutual fire support was impossible (p 13). This point is important, for it identifies a potential significant vulnerability in the Egyptian defense; hence, a tactical decisive point. This study concluded that mutual observation was possible from any three positions.

88. Dupuy, Elusive Victory, p. 159, and Gawrych, p. 24.

89. Unless specifically noted, the description of events during the battle of Abu Ageila is summarized from all previous sources listed.

90. Dupuy, Elusive Victory, p. 163 and Gawrych, p. 39-40. During the initial contest at Umm Qatef, Boulos was wounded or suffered a heart attack and was evacuated. He was replaced by Brigadier Saad ed-Din Mutawally. Apparently, Boulous loss did not significantly degrade the Egyptians' will to resist; hence, Boulous presence was neither a center of gravity or decisive point.

91. Gawrych, p. 52. Colonel Wallach, having determined that the Egyptians were encircled and cut off from their supplies, "saw no need to assault Abu Ageila." However, Chief of the General Staff, Moshe Dayan, intervened at this point in the battle and directed that Abu Ageial be conquered. The dirt tracks that Wallcah secured were not suitable for the movement of wheeled vehicles to ferry supplies forward.

92. Dupuy, Elusive Victory, p. 158-159, and Gawrych, p. 19.

93. S.L.A. Marshall, Sinai Victory, p. 106.

94. S.L.A. Marshall, Sinai Victory, p. 136, and Gawrych, p. 62.

95. Gawrych, p. 25.

96. Ibid., p. 30. Many senior officials disagreed on the proper employment of infantry and armor in the desert terrrain. In short, the Israel's Moshe Dayan measured the utility of tanks only as they supported the assaults of infantry. "He ignored many of the lessons of world War II..." (p. 28); consequently, through his interventions in the battle, tanks were never concentrated in mass.

97. Dupuy, Elusive Victory, p. 161, and Gawrych, p. 19-21, 30. In accordance with the Sevres agreement, the use of tanks was to be delayed until the 31st of October, by which time it would have been decided whether France and England would actually commit forces. If they had not, the airborne insertion into Mitla Pass, could have been labeled as a simple reprisal raid. Early arrival of tanks might also have triggered the Egyptian expected counterattacks before the blocking position at Mitla Pass was ready.

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Appendix A: Variables Influencing Combat Power

1. These variables are extracted from Huba Wass De Czege's Combat Power Framework. Each variable is a function of several other variables.

Firepower Effect

Volume of Fire
Lethality of Munitions
Accuracy of Fires
Target Acquisition
Flexibility of Employment of Weapon Systems

Maneuver Effect

Unit Mobility
Tactical and Operational Analysis (IPB and METT-T)
Management of Resources
Command, Control and Communications

Protection Effect

Concealment
Exposure Limitation
Damage Limitation

Leadership Effect *

Command, Control and Communications
Tactical and Operational Analysis (METT-T)
Doctrine

* In his model, Wass De Czege does not specify variables for this element of combat power.

Appendix B: Applied Combat Power Matrix

SUOMUSSALMI

	FINNS	RUSSIANS
FIREPOWER	+ SUOMI PISTOLS, EXCELLENT AT CLOSE RANGES - 28 RENAULT TANKS	- + AIR FORCE BOMBERS EFFECTIVE DURING DAYLIGHT + 3 TO 1 ARTILLERY AND MANPOWER ADVANTAGE + 2 T0 1 MACHINE GUN ADVANTAGE
MANEUVER	+ EXCELLENT SKI MOBILITY + FAMILIAR WITH TERRAIN -	- ROAD BOUND MOBILITY - LACKED SNOW PLOWS + CAN OPERATE DISMOUNTED + PREFERS WIDE OPEN TERRAIN TO MASS FIRES
PROTECTION	+ EXCELLENT CAMOFLAUGE + ACCLIMATED AND EQYIPPED FOR COLD WEATHER - OUTNUMBERED 3 TO 1	- POORLY EQUIPPED FOR ARCTIC CLIMATE - ONE LINE OF COMMUNICATION - FIRES FOR WARMTH EXPOSED POSITIONS AT NIGHT + TANK ARMOR
LEADERSHIP	+ SOCIAL UNITY AND DETERMINATION TO RETAIN INDEPENDENCE - UNSEASONED RESERVE OFFICER CORPS - AD HOC DIVSION ORGANINZATION - NO RADIOS BELOW REGIMENT	- COLD WET,HUNGRY AND CONSCRIPTED SOLDIERS - SENIOR LEADERSHIP EXPECTED EASY FIGHT, THIS MESSAGE FILTERED DOWN TO LOWER RANKS + ELITE 44TH DIVISION WAS NOT PREPASRED FOR ARCTIC WARAFRE

COMBAT POWER COMPARISON

SUOMUSSALMI

Finnish Significant Factors

- If detected, static defenses can be destroyed by overwhelming Soviet firepower (bombers, artillery and tanks) especially during daylight.

- Soviet weapons can not attain maximium ranges in forested areas.

- The Soviets must move their vehicles in column along the roads; therefore they will probably use infantry to clear the routes.

- Finnish infantry are more mobile than Soviet infantry because they are well equipped skiers.

Soviet Significant Factors

- Since the Soviets must conduct vehicular movement along the roads, they should clear the routes and secure the lines of communication with infantry.

- Soviet reconnaissance elements must detect Finnish infantry movements.

- Soviets must deploy to mass firepower against the Finnish defensive positions.

Conclusion: The Soviet's hub of power was their firepower. This strength was most effective when the Soviets were deployed in assault formations. To defeat the Soviets, the Finns had to prevent them from deploying. The best location and time to do this was along the roads in forested areas and at night -- decisive point. At these locations, the Finns used their ski mobility to its greatest advantage, ultimately defeating the Soviet center of gravity.

Appendix B: Applied Combat Power Matrix (Continued)

Abu Ageila

	Egyptians	ISRAELIS
FIREPOWER	+ 22 ARCHERS + 16 ARTILLERY TUBES, 25 POUNDERS + INTERLOCKING FIRES - 3000 SOLDIERS	- + 100 TANKS, SHERMAN M4 OR AMX 13 + 12000 SOLDIERS (NOTE 1)
MANEUVER	+ DEFENSIVE POSITIONS WITH INTERLOCKING VISIBILITY -LACK OF MOBILITY IN LOCAL RESERVE -DEPENDENT UPON SUPPORT FROM 4TH BRIGADE AT EL ARISH	- AMBIGUOUS DOCTRINE ON TANK AND INFANTRY - CONSTRAINTS ON EMPLOYMENT OF ARMOR + LARGE MECHANIZED RESERVE
PROTECTION	+ DUG IN TRENCHES -DAIKA PASS NOT ADEQUATELY PROTECTED -LOW ON WATER -ONE LINE OF COMMUNICAYTON	+ARMORED VEHICLES +LIMITED THREAT FROM ENEMY AIRCRAFT +NIGHT OPERATION
LEADERSHIP	+LEADERS AND SOLDIERS MOTIVATED +FAMILAIR WITH TERRAIN -	-UNDERESTIMATED ENEMY MORALE - CONSTRAINED FROM EMPLOYING ARMOR +

COMBAT POWER COMPARISON

Abu Ageila

Egyptian Significant Factors

- Without mobility and armor, the Egyptians cannot conduct a mobile defense.

- Daika Pass must be blocked or the Israelis can bypass the defense.

- The defense must concentrate at Umm Qatef. This dominant ridge is the best location to hold the Israelis for at least two days unitl the arrival of reinforcements.

- Because the Egyptians are short supplies and water, they must secure their lines of communication.

Israeli Significant Factors

- Before the Israelis assault Umm Qatef, they must block reinforcements from El Arish and the Suez.

- The Israelis do not have an overwhelming firepower advantage. Using the historical planning ratios found in table 2-3, CGSC ST 100-9, The Tactical Decision Making Process, (1993), they have adequate forces to attack with. This suggests that the defensive positions at Umm Qatef should not be assaulted directly unless all available firepower can be used. Operational constraints deny this option; therefore, the Israelis should attempt to defeat the Egyptians by cutting off their supplies and blocking reinforcement routes. Daika Pass is key to getting to positions to do this. It is vulnerable and decisive.

Abu Ageila

Conclusion: The Egyptian hub of power is their defense postioned on Umm Qatef. It is well prepard and can defeat limited Isareli assaults. However, it is dependent upon resupply from the Suez. The Israelis hub of power is their mobility and firepower advantage. But becuase of operational restricitons, it cannot be concentrated against Umm Qatef. Therefore, it should be applied to achieve superior comabt powere against Egyptian lines of communication -- decisive point.